1967

The relationship between food and fear

Henry Tjahjono
University of the Pacific

THE RELATIONSHIP BETWEEN FOOD AND FEAR

A Thesis

Presented to

the Faculty of the Department of Psychology

University of the Pacific

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Henry Tjahjono

August 1967

This thesis, written and submitted by

Henry Tjahjono ,

is approved for recommendation to the

Graduate Council, University of the Pacific.

Department Chairman or Dean:

Dr. W. Edgar Gregory

Thesis Committee:

W. Edgar Gregory , Chairman

David K. Bruner

Martin Gysbers

Dated October 6, 1967

Acknowledgements

The author is deeply grateful to all of the people who provided help and encouragement in bringing this thesis to completion. In particular, he is indebted to Dr. Martin T. Gipson, Dr. W. Edgar Gregory and to Dr. David K. Bruner for their wise, patient and sympathetic guidance. He also wishes to express his thanks to the Department of Physiology-Pharmacology, School of Pharmacy, which supplied him the subjects for his research. To Mrs. Judith A. Gipson goes his special thanks for her typing of this thesis.

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Chapter I

Introduction

Fear is one of the most important of the acquirable drives because it can be acquired so readily, and it can become so strong.

Traditionally, the procedure of feeding an organism in a fear-producing situation has been viewed as having a fear-reducing effect, called counterconditioning. English and English define counterconditioning as the procedure of conditioning a second and conflicting response to a conditioned stimulus that is not simultaneously being reinforced. Fear is reduced by conditioning to the fear-producing stimuli the incompatible emotional responses associated with eating (e.g.--Miller, 1951).

The strength of fear was illustrated by Miller in 1951. He found that albino rats, trained to run down an alley to secure food at a distinctive place and motivated by a 46-hour hunger, would pull with a force of 50 gm. if they were restrained near the food.

One of the earliest studies concerning the conditioning of fear was published by Watson and Rayner in 1920. They found that a usually phlegmatic 11-month old infant, called Albert, after reacting fearfully to the sound of an iron-bar loudly struck behind his head,

showed fear reactions to a white rat simultaneously with the noise and to other similar objects.

Because Watson and Rayner were not able to solve the problem of eliminating fear in Albert, Jones (1924) extended this research by examining the problem of elimination of a fear response to a conditioned stimulus. She approached the problem primarily through the procedure of "direct conditioning". This conditioning could be explained as follows. While the S was eating the fear-object was slowly brought in, and moved gradually to the S without interfering with his eating. After removing the fear-object, it was brought nearer to the S again until as his tolerance increased, the S could touch the fear-object.

Wolpe (1947, 1948) used the framework of counter-conditioning to study control and elimination of the fear response. Immediate responses to shock followed the same pattern in a group of cats whether they had previously acquired a feeding response in a experimental situation or not. These responses consisted of various combinations of the following symptoms: rushing back and forth, standing on the hind legs, clawing at the floor, roof and walls of the experimental cage.

In 1945 Mowrer and Ullman found that eating was not substantially influcenced by a comparatively weak shock

if the latter was delayed by as much as nine seconds. However, since hunger was fairly strong in that situation, the experiment did not provide a very sensitive indicator of the extent to which the stimuli produced by this particular behavior became conditioned to fear as a result of the occurence of the ensuing shock.

In 1954 Lane first gave animals shock-escape training in a Miller-Mowrer apparatus where shock occured on one side only, and then returned the animals to the fear compartment with the shock off. Food was presented intermittently to one group in the fear compartment, but not to the other. He found that the group that was fed ran out more slowly. Nelson (1965), however, pointed out that the effect of feeding was not clearly due to counter-conditioning, because the difference in escape times reflected an effect of feeding in conditioning motor responses incompatible with the measure of fear.

Nelson repeated Lane's study using a measure of the effect of counterconditioning that was less ambiguous by preventing the escape from the fear to the safe compartment during the last phase of the sequence. In addition, in order to minimize the conditioning of approach responses to food that may be incompatible with the measure of fear, the Ss were not fed intermittently, but were fed by being placed directly over a dish of food. He found out that

food can either slow down or hasten the extinction of fear, which supports an interpretation that the main effect of food on the level of fear is the effect of the feeding procedure on the amount of exposure to the stimuli for fear. It means that food has not a fear-reducing effect, but that food is an incentive for the Ss to submit themselves to fear. Food distracts attention from stimuli that normally would be conditioned to fear, i.e. the animal is not aware of them while eating.

Then Nelson did a second experiment to evaluate further the interpretation that exposure, and not counter-conditioning is the major factor in the relationship between food and fear. The experimental procedures were run in the following sequence: (a) Fear conditioning, (b) Introduction of food, (c) Measurement of residual fear. The interpolated experimental conditions were: (a) Incentive: freedom to move from one compartment to another with food always present in the shock compartment: (b) No incentive: similarly, freedom to move with no food present: (c) Incentive Control: being forced to spend an amount of time in the two compartments equal to the time spent in each compartment by a matched S in the incentive condition with no food present: (d) No-incentive Control: a similarly matched group for the No-incentive condition with no food present.

A comparison of the Incentive and No-incentive groups provided a means for evaluating the use of food as an incentive for increased exposure. Comparing the Incentive Control group with the Incentive group determined whether there was an effect of food, like counterconditioning, in addition to its effects as an incentive for exposure. Since the Incentive group is free to expose itself to the cues of fear, while the Incentive Control group is not, the Incentive group may therefore be favored by an aspect of extinction similar to Guthrie's (1935) "toleration" method, i.e. voluntary exposure implies that an S will expose itself only to as much fear as it can tolerate at one time. A comparison of the means of the Incentive Control group and the Incentive group suggested that there was no difference between the two conditions, evaluated by t tests ($t = .34$; $t = .37$).

Studies done by Farber (1948), Jones (1924) and Wolpe (1952) found that Ss fed in a fear-producing situation were consequently less fearful than Ss not receiving food in the situation. In Nelson's second experiment the results suggested that these experiments primarily reflected the effects of exposure.

The present experiment is designed to examine the difference in results between the Incentive and the Incentive Control groups, if the conditions are changed.

The Ss in the Incentive Control group are forced to spend an amount of time in the two compartments equal to the time spent in each compartment by a matched S in the Incentive condition, but with food present. The present experiment tried to indicate that at least for the Incentive and the Incentive Control groups the variable of free, as opposed to forced, exposure is a significant factor.

Chapter II

Method

Design. The study used a one-way factorial design analyzed with a one-way analysis of variance. The Ss were assigned randomly to the two cells, with 6 animals in each cell.

Incentive	Incentive
6	Control 6

Subjects. Twelve naive, male, albino rats, 90-120 days old, were kept in individual cages with water always available.

Apparatus. The apparatus consisted of two compartments, one with a grid floor and white walls, the other with a plain floor and black walls. The fear compartment measured 15 x 8 x 11 in., with a clear plastic top; its grid was made of stainless steel bars placed $\frac{1}{2}$ in. apart. A food dish was fixed to the grid at a point first 6 in. and then 10 in. from the door for each group, and it contained 15 gm. of dry ground Purina. The safe compartment was 14 x 8 x 11 in. with a clear plastic top and with a movable door opposite the door which separated the two compartments

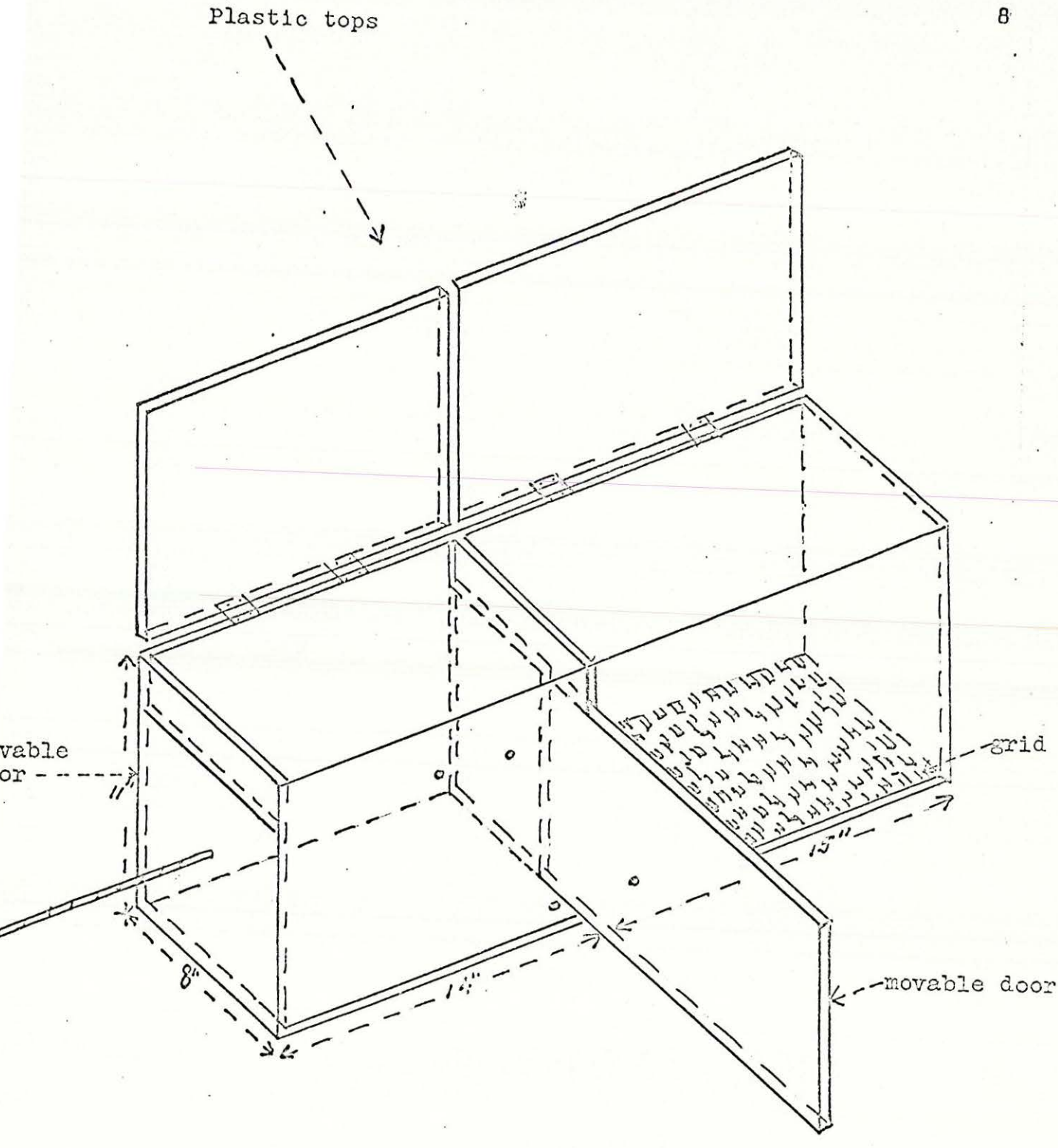

Fig. 1. Apparatus

to allow forcing the Ss in the Incentive Control group into the fear compartment. Photo-electric cells were used to measure escape latencies through a Creamer Timer during the assessment of residual fear. A stop watch was used to record the amount of time spent in each compartment during the experimental conditions (See figure 1).

Procedure. The experiment took 6 days. Twelve days prior to the first experimental day a daily regime of 10 gm. of dry ground Purina and one 5 gm. Purina checker was instituted. On the day prior to the first exposure trials food was completely omitted. The daily ration was always presented in a dish like the one used in the experimental conditions.

On day one each S was given two 3-min. trials of exploration in the apparatus. On day one and two, twenty shock trials per day were run. Two types of escape conditioning were jointly used on each S. One was the immediate-escape condition, in which the S was placed on a charged grid with the door between compartments opened. The second was the delayed-escape condition, in which the S was placed on an uncharged grid for 30 sec. with the door between compartments closed, following which shock was turned on. Three seconds later the door was opened. Delayed-escape trials were run on trials 26-35 and were

used in order to maximize the amount of fear conditioned. After the Ss had run into the safe compartment on each trial, they were detained for 20 sec. The intertrial interval of immediate-escape trials were 12 min. and that of delayed-escape trials were 20 min.

The experimental conditions, where food was introduced, started on days three and four. With shock turned off, each S received five 2-min. trials and one 10-min. trial on day three. Two 10-min. trials were given on day four. Each 2-min. trial was begun by placing S in the fear compartment; in each 10-min. trial, however, S was placed in the safe compartment. The procedure in the 2-min. trials were run in order to insure that Ss in the Incentive group saw that food was present in the fear compartment. The door between compartments was kept open throughout all the experimental trials of the Incentive group, but was closed throughout for the Incentive Control group. During the trials the number of entrances into the fear compartment was recorded, as was the total time spent in each compartment. An entrance was recorded any time the S completely left the safe compartment. The control Ss were first placed and confined there for a period of time spent there by their partner and then immediately placed into the other compartment and confined there for the remainder of the trial.

On days five and six Ss were given 30 trials per day of running from the fear to the safe compartment with shock, food, and dish absent. The S was placed in the fear compartment with the door opened; when the safe compartment was entered, the door was closed to prevent retracing. If S failed to run in 30 sec. in trials one to five, and in 120-sec. in trials 6 to 15, it was placed through the doorway into the safe compartment. If, after this period, two 120-sec. trials occured in a row, S was considered extinguished and not run again. The minimum intertrial interval was 5 min. The escape latencies were measured when S left the fear compartment and when S entered the safe compartment.

Chapter III

Results

The mean amount of time spent in the fear compartment by the Incentive group on the third day of the experiment was 6.6 min. and on the fourth day 9.0 min. (t = 2.9, $p<.01$): the mean number of entrances was respectively 5.0 and 3.6 (t = .31, non significant).

An analysis of variance was performed on the latency data, drawn from the fifth and sixth days of the experiment. This analysis yielded a significant main effect for the difference between the fifth and sixth days of the experiment (F = 6.0, $p<.05$). This difference was due to the difference between the means of the reciprocals of the latency times on the fifth day, equal to .141, and on the sixth day, .069. The analysis also yielded a significant interaction of Type of Exposure x Days of Testing (F = 6.0, $p<.05$). This is due to the greater differences of the means of the reciprocals of the latencies of the Incentive group on the fifth and sixth days (.109 and .045), as compared with the Incentive Control group means (.032 and .025). The summary of this analysis is shown in Table 1.

The average weights of the Incentive group and that of the Incentive Control group, as indicated in

TABLE 1

Analysis of Variance

Source	SS	df	MS	F
Between Subjects	.077	11	.007	
Type of Exposure (A)	.015	1	.015	2.5
Subjects within groups	.062	10	.006	
Within Subjects	.026	12	.002	
Day of Testing (B)	.006	1	.006	6.0*
A x B	.006	1	.006	6.0*
B x Subjects within groups	.014	10	.001	

* $p < .05$

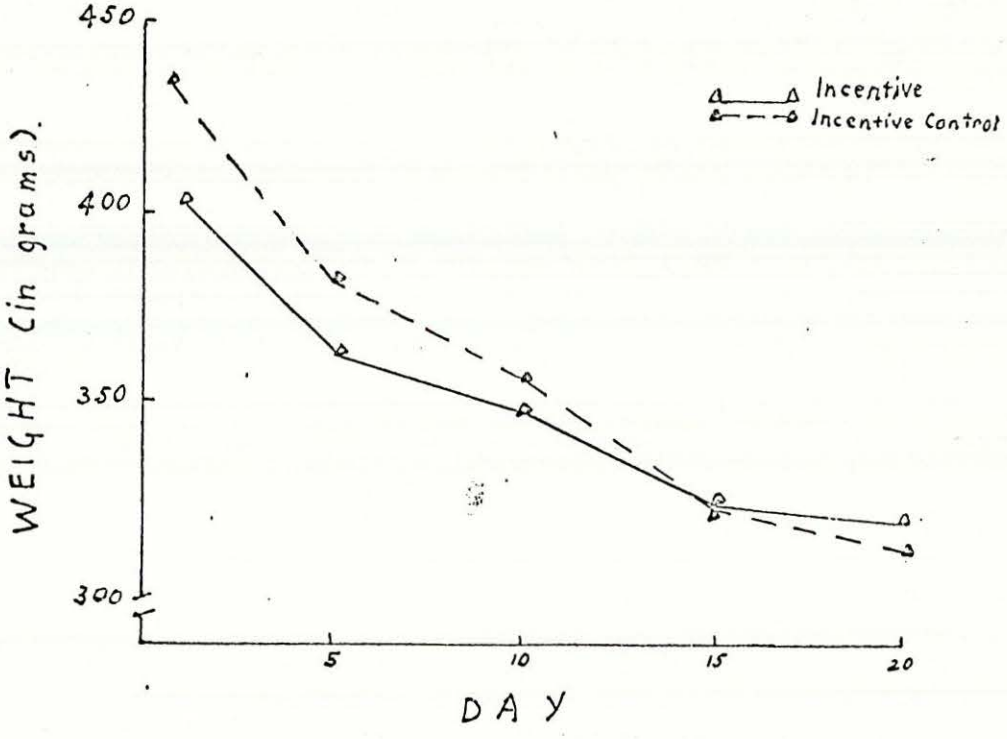

Fig. 2. Average weights of the Ss from the day that they were brought in until the last day of the experiment.

Figure 2, were respectively:

a. On the day when the Ss were brought in, 406.7 gm. and 432.3 gm.

b. On the first day of the diet, 382.6 gm. and 401.0 gm.

c. When the experiment started, 382.7 gm. and 382.2 gm.

d. On the last day of the experiment, 321.8 gm. and 316.2 gm.

Chapter IV

Discussion

As earlier stated in Chapter 1 the present study was designed to examine the ambiguity of the differences between the Incentive group and the Incentive Control group in Nelson's second experiment (1965). This study tried to indicate that at least for the Incentive group and the Incentive Control group the variable of free, as opposed to forced, exposure was a significant factor.

The results of the present study indicate that there is not an overall significant difference between the conditions of the Incentive and the Incentive Control groups, which is congruent with Nelson's findings.

However, the significant interaction between the type of exposure and the days of testing is not congruent with his findings. In addition to there being an overall adaptation to the fear compartment by day six, the Incentive Control group adapts more quickly to the situation than the Incentive group. The Incentive group runs almost as fast on the fifth day as on the sixth day, while the Incentive Control group runs much slower on the sixth day than on the fifth day (See Figure 3). In Nelson's study there are more slow runners in the Incentive group, and in this study the slow runners are in the Incentive Control group.

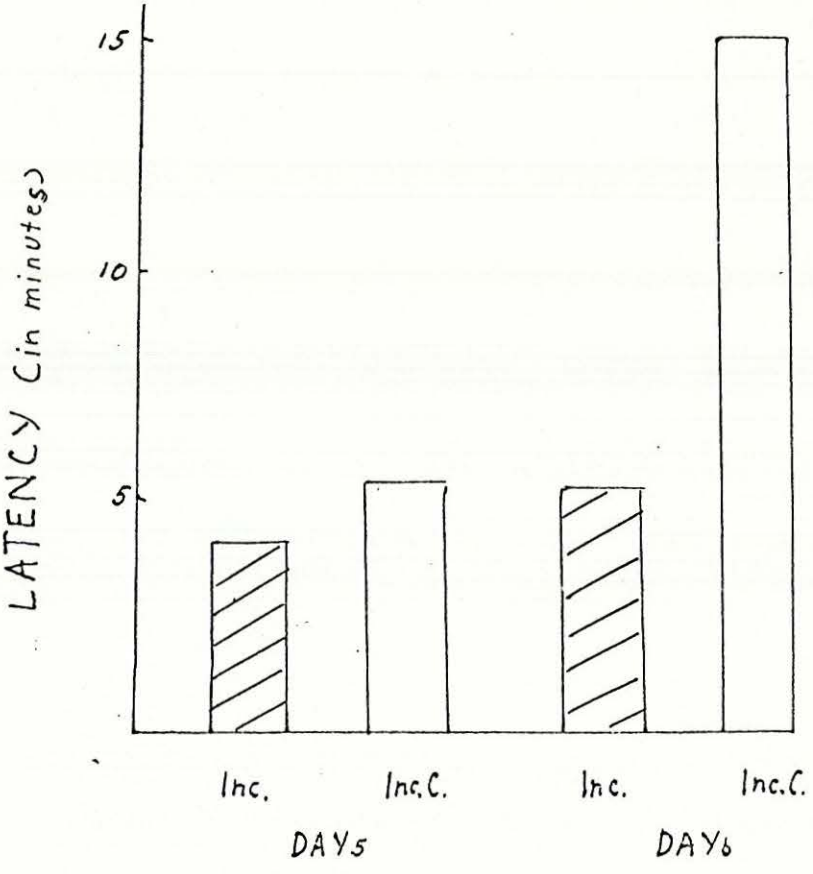

Fig. 3. Latencies of the Incentive and Incentive Control groups on the fifth and sixth days of the experiment.

Nelson has suggested that the difference between the Incentive and the Incentive Control group conditions in his experiment reflects a counterconditioning effect, which is secondary to the effect of food on exposure to the fear producing stimuli. This effect occurs in the following way. In the original fear conditioning situation shock is paired with the white compartment, so that the fear compartment comes to evoke the conditionable part of pain which is fear. During testing food, presented in the fear compartment, is an incentive for the Ss to submit themselves to this fear stimulus. Food additionally enhances the probability that the Ss will enter the fear compartment by initially directing the attention of the Ss away from fear producing stimuli. It thus provides the circumstances for the Ss to experience the conditioned stimulus, white compartment, without the unconditioned stimulus, shock, thus producing the circumstances for the extinction of the fear response.

The Incentive group is free to go back and fourth to the fear compartment on the third and fourth days of the experiment, while the Incentive Control group is not. The Incentive Control group is forced to spend a period of time in the fear compartment which is equal to the total amount of time that their matching partners in the Incentive group spend freely in the fear compartment.

It is probable that this forced exposure makes the Incentive Control group less fearful than the Incentive group, because the Incentive group has learned to reduce the fear by running into the safe compartment, while the Incentive Control group has learned to reduce the fear through eating. Reduction of fear probably occurs for the Incentive Control group through direction of attention away from the fear stimulus.

The difference between the means of the latencies of the Incentive group on the fifth and sixth days is not the same as that of the Incentive Control group. This indicates that there is not a counterconditioning effect, since the conditions for counterconditioning are the same in each group.

The difference between Nelson's findings and those of the present study is due to the fact that during this study food was always available for the Incentive Control group as well as for the Incentive group, while Nelson did not give food to the Incentive Control group. The absence of food in Nelson's study for the Incentive Control group removed the reward for remaining in the fear compartment that was present in this study.

Thus, in contrast to Nelson's study, this study shows that at least for the Incentive and for the Incentive Control group, the variable of free, as opposed to

forced exposure is the significant factor.

Chapter V

Summary

To extend and explain certain findings of Nelson (1965) on the nature of the counterconditioning phenomena, a study was designed to examine the ambiguity of the differences between the Incentive group and the Incentive Control group in Nelson's second experiment. The present study differed principally in the availability of food in the Incentive Control group condition. Twelve naive, male, albino rats, 90-120 days old, were used in a one-way factorial design, analysed with a one-way analysis of variance.

Latencies of escape were measured for the Incentive group and the Incentive Control group on the fifth and sixth days of the experiment. An analysis of variance on these latencies yielded a significant main effect for the difference in days of testing and it also yielded a significant interaction of type of exposure and days of testing.

In contrast to Nelson's study then, this study shows that at least for the Incentive group and the Incentive Control group, the variable of free, as opposed to forced exposure is the significant factor in the effect of feeding in a fearful situation.

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